Superdense massive galaxies in the nearby universe

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Abstract. At high-z the most superdense massive galaxies are supposed to be the result of gas-rich mergers resulting in compact remnant (Khochfar & Silk (2006); Naab et al. (2007)). After this, dry mergers are expected to be the mechanism that moves these very massive galaxies towards the current stellar mass size relation. Within these merging scenarios, a non-negligible fraction (1-10%) of these galaxies is expected to survive since that epoch retaining their compactness and presenting old stellar populations in the past universe. Using the NYU Value-Added Galaxy Catalog (DR6), we find only a tiny fraction of galaxies (∼0.03%) with $r_e \leq 1.5$ kpc and $M_* > 8 \times 10^{10} M_\odot$ in the local Universe ($z \sim 0.2$). Surprisingly, they are relatively young (∼2 Gyr) and metal rich ([Z/H] ∼ 0.2) These results have been published in Trujillo et al. (2009)

Keywords. galaxies: evolution, formation, stellar content

To investigate whether the distinct structural properties of our sample and a control sample are linked to differences in their stellar population properties, their global spectra and their luminosity-weighted ages and metallicities are analyzed on the basis of stellar population models.

With the global spectra it is found that the average compact galaxy looks clearly younger than the average control galaxy (Fig 1). Consequently, the metal lines of compact galaxies are weaker than those in the sample control. With the H$\beta_o$ vs [MgFe] grid, it is clear that compact galaxies are younger (∼2 Gyr) than the control ones (∼14 Gyr) as seen in Fig 2.

SFHs of our objects have been probed by means of STARLIGHT and the preliminary results show that for an average compact galaxy, more than 64% of the luminosity comes from the stellar populations younger than 3 Gyr, indicating that superdense massive galaxies are genuinely young objects.

Results

Superdense massive galaxies ($r_e \sim 1$ kpc, $M_\sim 10^{11} M_\odot$) were common in the early universe ($z \sim 1.5$). Within this scheme a non-negligible fraction (1-10%) of superdense massive galaxies is expected to survive intact since that epoch (Hopkins et al. 2009) and, consequently, they are supposed to have old stellar populations, which is at odds with our findings. Within the scheme of dry merging scenario, our result could highlight the importance of accounting for minor merging in order to make robust estimations in the number density of old superdense massive galaxies in the present Universe.

References

Figure 1. Mean spectra of the compact galaxies of our sample (black line) and the control galaxies (grey line). The inset shows the spectral region around H$_\beta$ and Mg lines showing the great difference in age between the compact and control sample galaxies.

Figure 2. H$_\beta$ vs [MgFe] diagram for 151 galaxies of a compact (filled squares, 18) and control samples (dots, 133) for which no $\lambda$5577 Å [OI] skyline residuals affect the index measurements. Overplotted are V99+SSP model grids with different ages (dotted lines) and metallicities (dashed lines) as given in the labels. The open square and circle are error-weighted mean indices for the compact and control samples respectively. Thick error bars show the $1\sigma$ index uncertainties, whereas the thin error bars correspond to the dispersions of the sample.